

We claim:

1. An apparatus comprising a receiver, wherein:  
said receiver has at least three degrees of freedom, wherein axes of said three degrees of freedom intersect; and  
said receiver receives an end effector, wherein said end effector removably couples to said receiver.
2. The apparatus of claim 1 further comprising said end effector, wherein said end effector comprises a catheter.
3. The apparatus of claim 1 wherein two of said three degrees of freedom are rotational and one of said three degrees of freedom is translational.
4. The apparatus of claim 1 further comprising pseudo skin, wherein said receiver is disposed beneath said pseudo skin.
5. The apparatus of claim 4 further comprising said end effector, wherein said pseudo skin lies in a plane between said end effector and said receiver, and wherein to simulate a vascular access procedure, said end effector crosses said plane to couple with said receiver.
6. The apparatus of claim 1 further comprising:  
a plurality of sensors, wherein said sensors:  
monitor movement of said receiver with respect to said degrees of freedom, wherein said movement is indicative of the position and orientation of said end effector; and  
generate signals indicative of said monitored movement; and  
a data processing system, wherein said data processing system receives signals generated by said sensors.
7. The apparatus of claim 6 and further wherein said data processing system determines a position and orientation of said end effector based on said received signals.

**8.** The apparatus of claim 1 wherein said receiver comprises a force-feedback assembly, wherein said force-feedback assembly generates a resistance to movement of said end effector.

**9.** The apparatus of claim 8 wherein said force-feedback assembly comprises a motor.

**10.** An apparatus comprising:

an end effector; and

a movable member, wherein:

said end effector reversibly couples to said movable member to simulate a vascular access procedure; and

said movable member moves along a linear path in response to manipulation of said end effector.

**11.** The apparatus of claim 10 wherein said movable member is coupled to a cable.

**12.** The apparatus of claim 11 wherein said cable is coupled to a motor.

**13.** The apparatus of claim 12 wherein, responsive to a control signal, said motor generates a resistance to movement of said movable member.

**14.** The apparatus of claim 11 further comprising a plurality of pulleys disposed on a frame, wherein:

said pulleys engage said cable; and

said pulleys are arranged so that a tension in said cable aligns with said linear path along which said movable member moves.

**15.** The apparatus of claim 11 wherein said movable member comprises a pulley, wherein said movable member is coupled to said cable via said pulley.

**16.** The apparatus of claim 10 wherein said movable member comprises a magnet, and wherein said end effector couples to said movable member via said magnet.

**17.** The apparatus of claim 10 further comprising a housing, wherein said movable member is disposed within said housing and said end effector is disposed outside of said housing.

**18.** The apparatus of claim 17 further comprising pseudo skin, wherein said pseudo skin is substantially co-planar with a surface of said housing.

**19.** An apparatus comprising a receiver for an end effector, wherein said receiver comprises:

- a frame;

- an arrangement for providing two orthogonal axes of rotation for said frame, wherein said frame is coupled to said arrangement; and

- a movable member, wherein:

- said movable member receives an end effector during a vascular access procedure;

- said movable member moves along a linear path in a region defined by said frame; and

- said linear path intersects said two orthogonal axes of rotation of said frame.

**20.** The apparatus of claim 19 further comprising a force-feedback assembly, wherein said force-feedback assembly is coupled to said movable member, and wherein said force-feedback assembly imparts a force that resists forward motion of said movable member by said end effector.

**21.** The apparatus of claim 20 wherein said force-feedback assembly comprises:

- a motor; and

- a cable, wherein said cable is coupled to said motor.

**22.** The apparatus of claim 21 wherein said movable member includes a rolling-contact element, wherein said cable is coupled to said rolling-contact element.

**23.** The apparatus of claim 21 further comprising a counterbalance, wherein said counterbalance is coupled to said frame.

- 24.** An apparatus comprising:  
pseudo skin; and  
a receiver for coupling to an end effector, wherein:  
said receiver is disposed beneath said pseudo skin; and  
said receiver has no offset degrees of freedom.
- 25.** The apparatus of claim 24 wherein a magnetic force is used for coupling said end effector to said receiver.
- 26.** The apparatus of claim 24 wherein said end effector is selected from the group consisting of a catheter, a needle, and a combined catheter and needle.
- 27.** The apparatus of claim 24 wherein said receiver has three degrees of freedom.
- 28.** The apparatus of claim 27 wherein two of said three degrees of freedom are rotational and one of said three degrees of freedom is translational.
- 29.** The apparatus of claim 24 wherein said receiver comprises a movable member, and wherein said movable member is movable along a linear path.
- 30.** The apparatus of claim 24 wherein said receiver comprises a movable member, and wherein said movable member is physically adapted for rolling contact during movement.
- 31.** The apparatus of claim 24 wherein said receiver is gravitationally balanced.
- 32.** The apparatus of claim 24 further comprising said end effector, wherein, until coupled to said receiver by a user, said end effector is disposed above said pseudo skin.

- 33.** The apparatus of claim 24 wherein said receiver further comprises:  
a movable member, wherein said movable member couples to said end effector; and  
a force-feedback assembly, wherein said force-feedback assembly is coupled to said movable element.
- 34.** An apparatus comprising:  
pseudo skin; and  
a receiver for coupling to an end effector, wherein:  
said receiver is disposed beneath said pseudo skin; and  
said receiver comprises a force-feedback assembly.
- 35.** The apparatus of claim 34 wherein said receiver further comprises a movable member, and wherein:  
said movable member is coupled to said force-feedback assembly;  
said movable member couples to said end effector;  
when said movable member is coupled to said end effector, movement of said end effector causes said movable member to move.
- 36.** The apparatus of claim 35 further comprising a data processing system, wherein, responsive to a signal from said data processing system, said force-feedback assembly generates a force that opposes movement of said movable member and said end effector, in at least a first direction.

**37.** An apparatus comprising:

- an end effector, wherein said end effector is a pseudo medical instrument;
- pseudo skin, wherein said pseudo skin is physically adapted to enable said end effector to pass through it to a first region beneath said pseudo skin;
- a data processing system, wherein said data processing system:
  - receives information indicative of a position of said end effector in said first region;
  - determines a position of a virtual end effector in a virtual anatomy based on said received information;
  - determines a resistive force that would arise if said virtual end effector were present at said position in said virtual anatomy; and
- a force-feedback system, wherein said end effector is coupled to said force-feedback system when said end effector is in said first region, and wherein said force-feedback system generates said resistive force, and wherein said resistive force opposes movement of said end effector in said first region in at least some directions.